

typically by pushing the syringe plunger as far as it will go into the syringe barrel thus urging the syringe hilt to move longitudinally towards the body cold end BCE, the syringe hilt will “hit” against the body cold end BCE creating somewhat of a “click” sound. Once this is done the syringe hilt, being longitudinally level again with the inner face IF, may again be rotated towards the first rotational orientation if desired.

[0108] Locking ring **50** may be employed in embodiments of syringe shield **S** and **Sa**, or other embodiments, and may be usefully made available as a standalone product that can be purchased as a replacement for a previously-used and potentially contaminated locking ring of the same or similar type.

[0109] With shield **Sb**, removal of cold end cover **CEC** from collar **3b** enables a syringe containing liquid material to be inserted tip first via collar **3b** and locking ring **50** into compartment **Cb** of elongate body **2b** while the syringe hilt is in a first rotational orientation until the syringe hilt is in contact with body cold end **BCE** of body **2b**. Depending on the size of syringe **1**, its tip may at this point reach body hot end **BHE** of body **2b** and be received within the inlet of puck **6b** if hot end cover **HEC** is connected to body **2b**. Furthermore, as described above, syringe **1** may at this longitudinal position be rotated past the shelf structure to the second rotational orientation, and then longitudinally pulled so as to recede slightly from the body cold end **BCE** thereby to engage and then be retained by the retention structure.

[0110] Cold end cover **CEC** and hot end cover **HEC** may be independently connected or disconnected from body **2b** depending on whether a syringe is being loaded or unloaded, is being contained for transportation or storage, or is being used to draw material out of syringe **1** while syringe **1** is being shielded by shield **Sb**. For example, a user may wish to load a syringe containing material into shield by removing only cold end cover **CEC** while hot end cover **HEC** remains connected at body hot end **BHE**. In this way, with hot end cover **HEC** in place, there is shielding in place at the hot end of shield **Sb**. However, it may be useful and appropriate to load a syringe **1** into shield **Sb** with hot end cover **HEC** disconnected from body hot end **BHE**. Transportation of a contained syringe **1** will generally require that both cold end cover **CEC** and hot end cover **HEC** are connected to body **2b**. During administration of the contents of syringe **1**, it may be useful to leave cold end cover **CEC** connected to body **2b** while hot end cover **HEC** is removed, so that the tip of syringe **1** is available to be Luer-connected to a conduit for conveying the liquid downstream from syringe **1**. Subsequent to this, it may be useful to remove cold end cover **CEC** thereby to enable a user or machine to depress the syringe plunger thereby to push the liquid out of the barrel of syringe **1** to continue downstream from syringe **1**. Furthermore, a user may wish to remove the cold end cover **CEC** to remove a pre-loaded syringe from shield **Sb**, to perform processes such as radioactive assay with a dose calibrator, which is required prior to administering any dose to a patient. Once the administration is complete, cold end cover **CEC** and hot end cover **HEC** can each be reconnected thereby to shield syringe **1** while it is transported for disposal.

[0111] In embodiments disclosed herein, thicknesses of hot/cold end covers as well as those of the tungsten pucks are all optimized based upon source shape (in this case

syringe size e.g. 1-60 cc's), source volume and type of radioactive emission (Beta, Gamma, Positron or mixed).

[0112] Another aspect of an overall shipping system in addition to the above-described shield, is an external container, preferably in the form of a shipping package or bag. There is known, and commonly used, a prior art shipping bag, known as a Type A IATA CFR49 compliant shipping bag. An example of such a bag may be seen at:

[0113] <http://www.biodex.com/nuclear-medicine/products/radiopharmacy/pro-tec-pig-and-accessories/pro-tec-pig-shipping-bag>

[0114] An example certificate of compliance for the bag is provided herein in FIG. **24**, which also includes references to various regulations pertaining to the bag and its suitability for use. This type of bag is an example of a package known to be used in Nuclear Medicine, particularly for the SPECT industry, which relies upon ^{99m}Tc radiopharmaceuticals. ^{99m}Tc is a low energy isotope. However, there are no known or viable (i.e., compliant with regulations) shipping options for high energy isotopes currently, to the knowledge of the applicant. Such high energy isotopes include, for examples, Ga⁶⁸, Lu¹⁷⁷, Zr⁸⁹, Sr⁸⁹ and Cu⁶⁴ based isotopes. The modularity of the above-described shield design and the optimization of a “universal” package size enables shipping of these emerging high energy isotopes the same way ^{99m}Tc is currently shipped. Specifically, the universal package when combined with the above-described modular shield will allow shipments to be treated and approved as Yellow-II category radioactive packages.

[0115] Embodiments of the shield in accordance with the invention may be combined as a system with an external package that complies with, inter alia, 49 CFR §§ 172.403 Class 7, 173.411-173.413, and 10 CFR § 71.

[0116] A universal package may be produced based on the principles herein, with particular utility for shipping I-¹³¹, Ga-⁶⁸, Zr-⁸⁹ and Cu-⁶⁴ isotopes. More particularly, while the I-¹³¹, Ga-⁶⁸, Zr-⁸⁹ and Cu-⁶⁴ applications are particular to certain syringe sizes and radiopharmaceutical volume and activity, the principles described herein are more universally applicable, particularly for emerging Theranostic agents that are in the mCi range, despite their energies being higher than I-¹³¹.

[0117] This type of bag is an example of a package known to be used in Nuclear Medicine, particularly for the SPECT industry, which relies upon ^{99m}Tc radiopharmaceuticals. ^{99m}Tc is a low energy isotope. However, to the knowledge of the applicant, there are no known or viable shipping options for high energy isotopes. Such high energy isotopes include, for example, Ga-⁶⁸, Lu-¹⁷⁷, Zr-⁸⁹, Sr-⁸⁹ and Cu-⁶⁴ based isotopes. The modularity of the above-described shield design and the optimization of a “universal” package size enables shipping of these emerging high energy isotopes the same way ^{99m}Tc is currently shipped.

[0118] In a preferred embodiment of the shipping system, an operator places the shield into the shipping bag in a generally vertical orientation, inserting the hot end of the shield into an appropriately-sized recess in a foam liner at the bottom of the bag. The operator then places a separate foam block on top of the shield to fill any space between the distal cold end of the shield and the opening of the bag, which closely invests around shield.

[0119] In this embodiment, the shield is suspended vertically within the Y plane, so that syringe is roughly centred within the three axes.